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Comparing seismic tomographic images from automatically- and manually-detected arrival times

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In this work we compare local earthquake tomographic images obtained using arrival times detected by an automatic picking procedure and by an expert seismologist.
For this purpose we select a reference dataset composed of 476 earthquakes occurred in the Trentino region (north-eastern Italy) in the period 1994-2007. Local magnitudes are comprised between 0.8 and 5.3. Original recordings are mainly from the Provincia Autonoma di Trento (PAT), and from other networks operating in the surrounding areas (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale – INOGS; Istituto Nazionale di Geofisica e Vulcanologia – INGV; others available via the European Integrated Data Archive).
The automatic picking of P and S phases is performed through a picker engine based on the Akaike information criterion (AIC). In particular, the proposed automatic phase picker includes: (i) envelope calculation, (ii) band-pass filtering, (iii) Akaike information criterion (AIC) detector for both P- and S-arrivals, (iv) checking for impulsive arrivals, (v) evaluation of expected S onset on the basis of a preliminary location derived from the P-arrival times, and (vi) quality assessment.
Simultaneously, careful manual inspection by expert seismologists is applied to the same waveform dataset, to obtain manually-repicked phase readings.
Both automatic and manual procedures generate a comparable amount of readings (about 6000 P- and 5000 S-phases). These data are used for the determination of two similar 3-D propagation models for the Trentino region, applying the SIMULPS code. In order to quantitatively estimate the difference of these two models we measure their discrepancies in terms of velocity at all grid points.
The small differences observed among tomographic results allow us to demonstrate that the automatic picking engine adopted in this test can be used for reprocessing large amount of seismic recordings with the aim of perform a local tomographic study with an accuracy comparable to the one obtainable with a complete manual data revision.